DENSITY OF ALASKAN SPRUCE GROUSE BEFORE AND AFTER FIRE[1]

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Abstract: An intense fire occurring on a previously established study area in August 1969 reduced the subsequent spring breeding density of spruce grouse (*Canachites canadensis*) by about 60 percent. At least 35 percent of the adults using the burn in spring-summer 1970 were birds that apparently were reluctant to abandon formerly established home ranges despite extreme alteration of the habitat by fire.

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In Alaska the spruce grouse inhabits most of the boreal forest which occupies roughly half the land area of the state. Nearly all of this forest type has been burned by lightning- or man-caused fires in the past 300 years (Viereck 1973:471). Although fire is a natural attribute of boreal ecosystems, little is known about the ecological effects of fire on northern wildlife populations. The purpose of this paper is to report on changes in density of spruce grouse on a previously established study area which burned unexpectedly.

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STUDY AREA

The study area was located on the Kenai National Moose Range in south-central Alaska. Before the fire, it included 1,040 ha of predominately spruce forest, characterized by extensive stands of black spruce (*Picea mariana*) on lowland sites and by mixed stands of white spruce (*P. glauca*), birch (*Betula papyrifera*), aspen (*Populus tremuloides*), and cottonwood (*P. trichocarpa*) on upland sites. Age of forest stands varied from 60 to 200 years, depending on occurrence of past fires. During 14–17 August 1969, a 36,000-ha fire burned about 70 percent of the study area. The 30 percent of the study area that did not burn was contiguous with several thousand km² of unburned forest.

The fire crept slowly across the study area during most of the 4 days, but at times wind caused fingers of the blaze to advance at speeds of up to 16 km/h. The fire was intense enough on roughly 75 percent of the burn to kill all trees, leaving standing charred spires, and to consume the 10–15 cm of organic matter overlying the mineral soil. Most of the intensely burned areas had been covered by dense black spruce or medium dense white spruce-birch stands with much dry moss in their understories, combinations which carried the fire well. On about 20 percent of the burn, the fire killed only 10–20 percent of the trees and did not burn down to mineral soil. These lightly burned areas were mostly open white spruce-birch stands with understories containing much green grass (*Calamagrostis canadensis*), which tended to retard the fire. The remaining 5 percent of the burned portion of the study area consisted of 12 scattered islands of live spruce stands 0.1 to 2 ha in

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Table 1. Densities of spruce grouse on burned and unburned areas before and after the fire of August 1969.[a]

Year	Burned			Unburned		
	Cocks on 364 ha	Hens on 728 ha	Total	Cocks on 156 ha	Hens on 312 ha	Total
July 1969	21	47 (42)[b]	68	5	18 (16)	23
May–July 1970	9	18 (18)	27	8	18 (16)	26

[a] Males were counted on only half of the area censused for females.
[b] Number of broods.

extent that escaped the fire because of either understories that did not carry the fire or vagaries of the wind. By July 1970, most of the burn was covered by a new growth of grasses, fireweed (*Epilobium* spp.), and horsetail (*Equisetum* spp.).

RESULTS

No evidence was found that any grouse died in the slowly moving fire. A search of the smoldering burn yielded no carcasses of any species of bird or large mammal, but dead voles (*Clethrionomys rutilus*) were found. Data from banded birds, and concentrations of birds on the perimeter of the burn, also suggested that most grouse escaped the fire. Eighteen of 38 adults banded during 5 weeks before the fire in habitat that later burned were seen during the ensuing year within or near the burn. Concentrations of grouse were noticed just outside the burn immediately after the fire. During 12–19 September 1969, a systematic search with a dog of 120 ha of unburned forest bordering the burn resulted in a count of 116 birds (97/km^2), a density more than twice that of pre-fire densities of 40 birds/km^2 in early August (Ellison 1974, Tables 1, 3). This concentration of birds was temporary, and casual observations suggested that most of the extra birds had dispersed by November. Data from banded birds taken by hunters indicated that some of these dispersing birds were adults that moved as far as 5–10 km from the burn (Ellison 1973:381).

Detailed telemetry studies during the two winters following the fire (Ellison 1973) revealed that some individuals spent all or most of the winter in the burn, where they obtained their winter diet of spruce needles from unburned trees. No data were obtained on winter densities in the burn.

Breeding densities were determined by counting cocks in July 1969 and May 1970 on half of the original 1,040-ha study area, and by counting hens in July of both years on the entire study area (Table 1). The fire burned about 70 percent of each census plot. Counts were made by systematic searches with a dog (Ellison 1971, 1974). The total number of cocks and hens found on the unburned portion of the areas searched was about the same before and after the fire (23 vs. 26), but a significant decline occurred on the burn, with 68 birds being found before the fire and 27 afterward (chi-square test of independence, $P < 0.01$, $\chi^2 = 7.42$). In other words, the fire apparently reduced the breeding population on the burn by at least 60 percent. If some of the hens with broods that were encountered in areas of ash and mineral soil were simply transients passing through the burn, then the actual reduction in breeding density was greater than 60 percent. Apparently some hens nested in the burn, for one nest was reported found in ashes under a charred log 200 m inside the burn (L. Engel, personal communication). Most cocks found in the burn in May 1970 were associ-

ated with islands of unburned trees. It is not known how many were territorial, but at least one had established his territory in a lightly burned area (Ellison 1973).

In spring-summer 1970, the breeding population in the burn included both yearlings (birds that were juveniles at the time of the fire) and birds two years of age or older. Among 23 adults captured in the burn in spring or summer 1970, 15 (65 percent) were 2 years old or older; among 30 captured outside the burn, 12 (40 percent) were 2 years old or older (ratios not significantly different, $P > 0.05$). Of the 15 birds 2 years old or older captured in the burn, 7 had not been banded before the fire and thus their origin was not known. The other 8 (3 males, 5 females) had been banded before the August 1969 fire within 300 m of their 1970 location. Hence, at least 35 percent (8/23) of the breeding population using the burn in summer 1970 consisted of adults 2 years old or older whose former home ranges probably lay within the burn. Their use of the burn may have reflected a reluctance to totally abandon previously established home ranges despite extreme physical alteration by fire. Adult birds of many species show a similar site tenacity for the familiar surroundings of an established home range even though vegetation structure may be drastically altered by either fire or natural succession (Hildén 1965, Emlen 1970, Doerr et al. 1970, Sharp 1970, Bendell and Elliott 1967).

DISCUSSION

The apparent reduction in breeding density of 60 percent one year following fire should not be interpreted to be the general effect of fire on Alaskan spruce grouse. The effect will vary with the extent, intensity, and patchiness of the burn. Also, it is likely that more birds will be found along the edge of a burn, where there is simultaneous access to burned and unburned habitat, than farther out in the burn. In this study, counts in the burn were made within 1.6 km of its edge. Counts made deeper within the burn or in more intensely burned habitat probably would have indicated a reduction of more than 60 percent.

This reduction is similar in magnitude to that recorded in a ruffed grouse (*Bonasa umbellus*) population in Alberta (Doerr et al. 1970), which was reduced by half in the first and second springs following a fire in May that burned 84 percent of the study area. However, among blue grouse (*Dendragapus obscurus*) on Vancouver Island, fire may have no immediate effect on breeding densities if the fire occurs in habitat already in early stages of succession (Redfield et al. 1970:73). The birds seem quite well adapted to breeding in areas consisting of little more than ash and mineral soil.

In the boreal forest of Alaska, spruce grouse habitat consists of a rather closed-canopied, coniferous forest found in late stages of succession. Following fire in this habitat, deciduous stands of aspen and birch develop on well-drained sites (Viereck 1973), and these stands may be occupied by ruffed and sharp-tailed grouse (*Pedioecetes phasianellus*) (Weeden 1965, P-R Job Prog. Rep., Proj. W-6-R-5, Alaska Dept. Fish Game, Juneau). Eventually, white spruce will invade the deciduous forest, and succession will lead to the development of spruce grouse habitat. Though spruce grouse prefer the coniferous habitat of later stages of succession, this does not necessarily mean that fire is entirely detrimental to habitat of spruce grouse in Alaska. Wilde and Krause (1960) suggested that in the absence of fire white spruce ultimately might be replaced by open black spruce bogs as the result of permafrost development. Since open black spruce bogs are not

the preferred habitat of spruce grouse in Alaska, and since fire retards permafrost development by setting back vegetation succession, then a certain frequency of fire may be necessary to maintain grouse habitat.

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